Learning through Foreign Market Participation: The Relative Benefit of Exporting and Foreign Direct Investment

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Introduction

This paper addresses the current debate on "learning by exporting." It is clear that firms that export are more productive than those that do not. Early research indicated that this occurs because more productive firms choose to export, suggesting that firms do not learn much via exporting (e.g., Bernard & Jensen 1999; Delgado et al. 2002). However, a recent series of studies finds that those firms that choose to export subsequently enjoy more success at technological innovation, suggesting that firms can access new, diverse knowledge through the act of exporting (e.g., Salomon & Shaver 2005). Yet one gap in the current debate is the focus on exporting as the sole form of international activity, when in reality firms pursue a range of internationalization options and each of these options offers potential opportunities for acquiring technological knowledge.

In this study we explore the effect of two internationalization options on a firm's subsequent innovativeness. In particular, we examine the relative effects of 1) exporting products and 2) foreign direct investment. We develop theoretical predictions regarding the speed with which such internationalization should affect a firm's innovation, and regarding the extent of such effects.

We then test these predictions using data from the Fundacion Empresa Publica's annual surveys of Spanish manufacturing firms from 2000 through 2005. We find that exporting generates a more substantial increase in a firm's innovativeness than does foreign direct investment. We also find that the effect of exporting occurs more quickly than the effect of foreign direct investment. This is consistent with the notion that exporting can occur rapidly, while foreign direct investment requires a longer "ramp-up" period to build or integrate foreign

facilities and establish relationships. Finally, we find modest evidence that exports and foreign direct investment operate as substitutes in terms of enhancing a firm's innovative learning.

Overall, our results are consistent with prior research that finds a relationship between exporting and subsequent innovativeness. These results also extend prior research by highlighting these effects relative to alternate forms of internationalization.

Review of the Literature and Hypotheses

Early research in international business focused on the ability of a firm to exploit existing assets and capabilities, particularly knowledge-based capabilities, by expanding into new markets. Indeed, the fundamental motivation for internationalization was long viewed as resource exploitation (Hymer 1960 [1976]; Dunning 1974). Yet research in the 1990s began to propose an alternate resource-seeking motivation for internationalization activities. According to this view, a firm might establish operations or otherwise participate in a particular country in order to gain access to useful knowledge that it could combine with its domestic strengths (Wesson, 1997). Thus, a firm might choose to set up in another country to access the host country's advanced technological knowledge (Kogut & Chang 1991; Shaver & Flyer 2000), or perhaps to learn how to serve advanced customers' needs.

One manifestation of this resource-exploitation vs. resource-seeking debate has been a series of studies that explore whether firms that export are more productive because it is the more productive domestic firm that will choose to export (which would be consistent with resource-exploitation) or because a firm that exports will become more productive through its exporting activities (which would be consistent with resource-seeking). In terms of a firm's financial performance, the evidence has generally been mixed: a number of studies on exporting and conventional measures of productivity indicate that firms that are more productive begin to export (e.g., Clerides, Lach & Tybout 1998; Bernard & Jensen 1999; Delgado, Farinas & Ruano 2002), while others find that firms that export subsequently become more productive (e.g., Aw, Chung & Roberts 2000; Ozler & Yilmaz 2001; Blalock & Gertler 2004).

Yet one line of research offers an unambiguous result: exporting appears to enhance a firm's ability to innovate. In a series of studies, Salomon and colleagues have proposed that participation in international activities provides opportunities to learn that might not be reflected in conventional measures of productivity (such as labor productivity or total factor productivity), but rather in more direct measures of a firm's knowledge base, and they have found evidence that exporters subsequently innovate more than non-exporters, even after controlling for the initial innovativeness of the firms (e.g., Salomon & Shaver 2005; Salomon & Jin 2008). Thus, one stylized fact from this literature is that exporting by a firm leads to enhanced innovation, in terms of patents and in terms of new products.

But how does this compare to the effect of foreign direct investment (FDI) on innovative learning? Although there have been no studies that compare the effect of exporting on innovative learning to that of FDI, we can generate three predictions by building on related prior literature.

First, foreign direct investment is typically a more significant undertaking than is exporting. Whereas exporting entails little or no investment in physical assets in a host country, foreign direct investment often requires significant investments that may be irreversible (Anderson & Gatignon 1986; Henisz 2001). FDI thus represents a more substantial commitment to a country than does exporting, as well as a greater degree of interaction. For this reason, Salomon & Jin (2008) speculate that FDI will lead to more substantive learning than will exporting. Second, because foreign direct investment is a more significant undertaking, FDI takes longer to "ramp-up" than does exporting. As such, it is likely to take longer to get activities fully functioning when a firm uses FDI than when it relies on exporting. Thus, learning associated with FDI may take longer to occur than learning associated with exporting. Finally, firms typically export first and conduct FDI later (Johanson & Vahlne, 1977). To the extent that learning from participating in a foreign country occurs in the early years of participating in that country, this suggests that a firm that engages in FDI as well as exporting will learning less from

that FDI than a firm that engages in FDI alone – in other words, exporting and FDI will behave as substitutes.

H1: Foreign direct investment will be more positively associated with innovative learning than will exports.

H2: The impact of foreign direct investment on a firm's innovative learning will exhibit a greater lag than the impact of exporting on a firm's innovative learning.

H3: A firm's exports and its foreign direct investment will function as substitutes in terms of their impact on the firm's innovative learning.

Data and Methods

Sample

To test the above hypotheses, we need data on the exporting, importing and foreign direct investment of a comprehensive sample of firms. We obtain these data from an annual survey of Spanish manufacturing firms conducted by the Fundacion Empresa Publica in conjunction with the Spanish Ministry of Industry. Each year since 1990, the Fundacion has surveyed a stratified sample of Spanish manufacturing firms that includes firms that have at least 200 employees and a randomly selected 5% of firms with at least 10, but fewer than 200, employees. In the years 2000 and later, the Fundacion's survey included questions concerning foreign direct investment activities, which are particularly relevant to the above hypotheses. We therefore use the survey data from years 2000-2005 to test our hypotheses. All the information included is subjected to validation and logical consistency controls by Fundación SEPI.

The sample included information on 1870 firms from 20 industries (see Figure 1 for breakdown by industry).[1] Not every firm appears in every year of the survey, however. Consequently, we have a total of 9967 firm-year observations for these 1870 firms.

[1] Following Salomon & Jin (2008), we dropped all observations for firms that were classified into the "Miscellaneous Manufacturing" industry.

[INSERT TABLE 1 ABOUT HERE

The Fundacion survey collects data about a firm's innovation outcomes as well as its engagement in exporting, importing, and foreign direct investment. A significant subset of our sample engages in these activities, as shown in Table 2. As the Table notes, roughly 64% of the sample companies engage in exporting through the 6 years of the panel, and roughly 13.% of the firms engage in foreign direct investment during this time period.

[INSERT TABLE 2 ABOUT HERE]

Dependent Variables

We predicted that a firm's engagement in exporting, importing, and FDI activities would affect its acquisition of technological knowledge. To test this empirically, we use two different proxies for a firm's technological knowledge, or what Salomon & Shaver (2005) call a firm's innovative productivity. Each measure has its own advantages and disadvantages; together, they offer a more comprehensive view of a firm's innovation-related learning.

Patent application count: $PATENTS_{jt}$. Our first dependent variable is the number of patents applied for by firm j in year t. The Fundacion survey asks each respondent to reveal the number of patent applications submitted by the respondent's firm to the European Patent Office and to the Spanish Industrial Property Registry in a given year.[2] Patent data have been used extensively in technology and innovation literature research as a measure of innovative output (Scherer, 1965; Comanor and Scherer, 1969; Bassberg, 1962, 1987; Henderson and Cockburn, 1994, 1996). Although patent data have several well-known flaws – not all technological knowledge is patentable; not all patentable knowledge is patented; different firms and industries

[2] The number of patents applied for by a firm does not correspond with the successful ones. Approximately the successful rate is 67% (EPO, 2000) which give a useful variable for approximate the total number of innovation archived by the firm (Salomon and Shaver, 2005).

have different propensities for patenting (Levin et al. 1987; Salomon 2006) – such data are generally seen as a valid albeit noisy measure of a firm's innovation (Griliches 1990; Archiburgi & Pianta 1996). Nevertheless, given the perceived weaknesses of patent data, we construct a second measure of innovative learning, defined below.

Product innovation counts: NEW PRODUCTS$_{jt}$. Due to the potential concerns associated with patent data, we construct a second dependent variable based on new products introduced by firm j in year t. The Fundación survey asks each respondent to reveal the number of new and substantively modified products introduced by the respondent's firm in a given year. The number of new products has been used as a proxy for innovative output in a variety of empirical studies (Comanor and Scherer, 1969; Pavitt, 1984; Pavitt et al., 1987; Acs and Audrestch, 1989; 1990). The primary drawback to such a measure of innovative output is that it is difficult to collect such information relative to patent counts (Silverman 2002). We take advantage of the Fundacion's efforts to collect this information.

Independent Variables

Exports. Above, we hypothesized that a firm's exports will influence its innovative learning. The Fundacion survey asks each respondent to reveal the total dollar value of its firm's exports in a given year. We construct three different variables to measure exporting activity. **EXPORTDUM$_{jt}$** is a categorical variable that takes the value of 1 if firm j engages in any exporting in year t, and 0 otherwise. EXPORTDUM captures whether or not the firm is engaged in exporting behavior in a given year. **EXPORTS$_{jt}$** is a continuous variable set equal to the dollar value of exports by firm j in year t. EXPORTS captures the intensity of export-based interaction experienced by firm j. Finally **LnEXPORTS$_{jt}$** is measured as the natural log of (EXPORTS + 1). LnEXPORTS captures the intensity of export-based interaction experienced by firm j, but allows for a diminishing marginal effect of such interaction on a firm's innovative outcomes.

FDI. Above, we hypothesized that a firm's FDI will influence its innovative learning.

Authors have argued that firms must establish a physical presence in the host environment in order to benefit from the Marshallian location externalities (Marshall, 1920; Kogut and Chang, 1991; Cantwell, 1993; Almeida, 1996; Siotis, 1999; Salomon and Shaver, 2005). As such, a measure of whether the firm has a subsidiary physically established in foreign market is developed in FDI_DICO that takes the value of 1 if the firm has a subsidiary in a foreign country and zero otherwise. Therefore, we define the variable LNFDI that is the natural log of the number of subsidiaries a firm has abroad plus one. We also lag the FDI variables too for the same reason commented above.

The Fundacion survey asks each respondent to reveal the total number of its firm's foreign subsidiaries that are operating in a given year. We construct three different variables to measure FDI activity. $\mathbf{FDIDUM_{jt}}$ is a categorical variable that takes the value of 1 if firm j has any foreign subsidiaries in year t, and 0 otherwise. FDIDUM captures whether or not the firm is engaged in FDI in a given year. $\mathbf{FDI_{jt}}$ is a count of the number of foreign subsidiaries operated by firm j in year t. FDI captures the intensity, or perhaps more accurately the breadth of FDI activities experienced by firm j. Finally $\mathbf{LnFDI_{jt}}$ is measured as the natural log of (FDI + 1). LnFDI captures the intensity or breadth of FDI-based activity experienced by firm j, but allows for a diminishing marginal effect of such activity on a firm's innovative outcomes.

Imports. Above, we hypothesized that a firm's imports will influence its innovative learning. The Fundacion survey asks each respondent to reveal the total dollar value of its firm's imports in a given year. We construct three different variables to measure importing activity. $\mathbf{IMPORTDUM_{jt}}$ is a categorical variable that takes the value of 1 if firm j engages in any importing in year t, and 0 otherwise. IMPORTDUM captures whether or not the firm is engaged in importing behavior in a given year. $\mathbf{IMPORTS_{jt}}$ is a continuous variable set equal to the dollar value of imports by firm j in year t. IMPORTS captures the intensity of import-based interaction experienced by firm j. Finally $\mathbf{LnIMPORTS_{jt}}$ is measured as the natural log of (IMPORTS + 1). LnIMPORTS captures the intensity of import-based interaction experienced by

firm j, but allows for a diminishing marginal effect of such interaction on a firm's innovative outcomes.

As noted in the theoretical section above, knowledge takes time to flow back from foreign operations and be incorporated in the activities of the firm; the benefit of exporting may not be realized until future periods. For that reason, and consistent with prior literature, we lag our export and FDI variables one, two and three years in our estimations (Bernard and Jensen, 1998, 1999; Clerides et al, 1998; Salomon and Shaver, 2005).

Control Variables

Several other characteristics of a firm can affect that firm's innovative outcomes. Consistent with prior literature in this area (i.e., Salomon& Jin, 2008), we control for three likely effects. Prior scholarship indicates a relationship between innovation and firm size (e.g., Cohen, Levin & Mowery 1987), and firms that export or engage in FDI tend to be larger than those that do not. We therefore control for firm size by including $\mathbf{LnSIZE_{jt}}$, which is measured as the natural log of (employees + 1) for firm j in year t. We use employment rather than sales as a measure of firm size because of concerns about the direction of "causality between product innovations and sales" (Salomon and Shaver, 2005). Prior scholarship also indicates a relationship between innovation and firm R&D intensity (e.g., Cohen & Levin 1989). We therefore control for this by including $\mathbf{R\&DIntensity_{jt}}$, which is measured as R&D expenditure divided by sales for firm j in year t. Finally, it is possible that firms that have strong brands will tend to introduce more new products than those without such brands, and strong-brand firms will also tend to engage in more exporting or FDI. To control for this, we include $\mathbf{AdvIntensity_{jt}}$, which is measured as advertising expenditure divided by sales for firm j in year t.

Descriptive Statistics

Figures 1 and 2 show the evolution of our dependent variable, innovative activity, with respect to FDI/no-FDI and exporting and no-exporting firms over the period 2000–2005 in our

sample. Both figures show a clear decrease in innovative activity immediately following the September 11, 2001 terrorist attack and subsequent economic and political turmoil. The post-2001 upward trend is clearly greater in exporting and FDI firms, especially in the post-2003 time period.

[INSERT FIGURES 1 and 2 ABOUT HERE]

Table 3 displays the correlation matrix and descriptive statistics for the dependent and independent variables for the full sample. Not surprisingly, the correlations are quite high among variables that are different lags of the same construct, for example ExportDummylag1 and ExportDummylag2. This implies that we may have difficulty incorporating multiple lags in a single model, but otherwise does not affect our estimations. The correlations between export measures and FDI measures are generally modest. In the next section, we turn our attention to a statistical analysis of exporting and FDI on innovative learning, through multivariate models.

[INSERT TABLE 3 ABOUT HERE]

Specification of the Model

Our dependent variables are counts with non-negative integer values, and many of them bunched at zero. Therefore, several assumptions underlying linear regression models are violated – for example, assumptions concerning homoscedastic, normally distributed error terms. Following prior literature, we use negative binomial regression estimation to conduct the analysis (Hausman et al., 1984; Blundell et al., 1995; Nadolska and Barkema, 2007; Salomon, 2006; Salomon & Jin, 2008).

As we are operating with panel data, we modify the original negative binomial regression to allow random effects over time. So, our final specification of the model, using a conditional maximum likelihood approach, is:

$$\text{Prob}[Y=y_{it}\,\varepsilon] = e^{-\lambda_{it}\exp(\varepsilon)}\,\lambda_{it}^{\ y_{it}} / y_{it}!,\ y = 0,1,...$$

$$\ln\lambda_{it} = \beta'\mathbf{x}_{it} + u_i + \varepsilon_{it}$$

Results

We estimate negative binomial models of innovative learning. Tables 4 and 5 display models that estimate innovative learning as measured by the dependent variable NewProducts, as a function of Exports and FDI dummy variables (Table 4) and Export and FDI intensity (Table 5). Tables 6 and 7 display the results of identical models in which innovative learning is measured by Patents. All models include firm random effects. Each table displays the results of model specifications. Models 1 to 3 present results for the Exports variable. Models 4 to 6 replicate these results for the FDI variable. Finally, Model 7 to 9 introduce Exports, FDI, and the interaction between these two variables. All cited variables are lagged 1, 2 or 3 years in order to explore timing effects, given that prior literature has noted that knowledge takes time to filter back to the focal firm and be incorporated in its activities (Salomon and Shaver, 2005).

[INSERT TABLE 4 ABOUT HERE]

Table 4 shows positive and significant coefficient for ExportDummyLag1 and ExportDummyLag2. which shows how exports increase the probability of increasing the number of product innovation in the first and the second year. This is consistent with prior research on the export-innovative learning relationship. Turning to the negative binomial regression results in model 4-6, the positive and significant effects of FDI_DICO_LAG1 and FDI_DICO_LAG2 imply the same logic supported before. Finally, if we introduce all the independent variables and its interaction together, we observe that the main results for slack remain almost the same; exports became positive and significant for the three lagged years. the

lagged years 2 and 3. Interestingly, the interaction between exports and FDI is highly significant only for the year (t-3).

We follow a similar procedure to test our hypotheses in Table 5. Coefficients for some independent and control variables are somewhat different, that fact reflects the adjustments made when we introduce the intensity in place of status variables. The results are consistent about exports, except for the year (t-3) that is positive and significant too. Some noticeable changes in the results can be observed if we analyze the lagged LNFDI that variables are not significant. Overall, we interpret the pattern of results to indicate that learning associated with FDI occurs with a greater lag than that of exports (consistent with H2), that the overall amount of learning associated with FDI is less than that associated with exporting (not consistent with H1), and that exporting functions as a substitute to FDI in terms of generating innovative learning (consistent with H3).

[Introduce Table 5]

We now turn to the control variables in Tables 4 and 5. In Table 4, the results for the lagged NIP control variables indicate that there is a positive and significant effect over the future number of innovative products, but only for the years (t-1) and (t-3). So, these coefficients suggest a feedback effect between the past NIP and the future (Salomon and Shaver, 2005:446). The results for the rest of control variables, RESEARCH, LNSIZE, ADVERT, are positive and significant for every model but the LNSIZE for the models 3 and 4; and ADVERT for models 6 and 9. Table 5 shows that the results from negative binomial regressions are fairly consistent about the lagged variable NIP. For the rest of control variables we find that all of them are positive and significant, except for ADVERT for the model 3.

We next test the robustness of our claims by comparing the previous results against the ones obtained by using an alternative dependent variable. Tables 6 and 7 use PATENT_SPAIN

variable in place of NIP; therefore, the measurement used to gather information about exports and FDI is the dichotonomous option (in Table 6) and natural log (in Table 7).

[Introduce Table 6 and Table 7]

Contrary to the findings associated with new product introduction, it seems that there is no main effect of FDI on the patent activity. The results should be interpreted with caution, because of the different types of information gathered by the two dependent variables. While NIP is collecting the entire number of product innovation (both new products as modified ones), PATENT_SPAIN is only covering the innovations that have been protected by law in the Spanish territory. So, it is easy to think that NIP variable accomplish more exact information about the innovative output than PATENT_SPAIN when we are focus in foreign countries with direct investment. That could be due to several factors: firstly, when companies are located abroad the feedback speed slows down because of time, language and cultural differences. So, as global companies are located in dynamic industries, patent processes are going to delay in excess the normal company rhythm. Secondly, if the company decides to patent its inventions, the Spanish patent could be useless in the foreign country if its laws do not recognize our intellectual property right system. These reasons could make the PATENT_SPAIN variable incomplete and no recommended for analysis focused on companies which pursue FDI.

By contrast, similar results hold when we pay attention to exporting firms. As before, the results imply that exporting firms may exert a great influence over innovative counts. In this case, columns 1-3 and 7-9 present lagged models where every export lagged variable has a significant impact over the propensity to patent. So, when firms just export the invention they produce they seem to patent more frequently than when they chose a FDI to be present in the foreign country. Nevertheless, we interpret these results as consistent with those in Tables 4 and 5 in terms of the greater effect of exports than FDI on innovative learning, which is a provocative finding.

Other results are somewhat different from the reported in Tables 4 and 5 too. It is the information related with advertising activities. So, ADVERT presents no influence over patenting behavior in any model (although it had a great impact over NIP).

Finally, a slight different can be notice with the lagged variable PATENT_SPAIN, introduced in place of the lagged NIP, to control if previous patents influence in the future innovations developed by the firm. The results imply a significant relationship between the past and the future. Interestingly, these effects change over time. So, the effects of patents in year (t-1) are not significant, but the patents in year (t-2) are significant and negative. It is not until the year (t-3) where the effects become significant and positive. This evolution may point to financial and timing requirements. In that way, companies only patent innovations that are substantially different from previous ones and its modification must be protected from competence for a long time. This logic could explain why companies which patent an innovation in one year are not going to patent anything until several years after that, because they need time to develop a really new product and they are not going to invest their money patenting slightly modifications that are going to be modified rapidly for the dynamism in the market.

Conclusion

The debate over resource-seeking and resource-exploiting foreign activities has focused recently on the export-productivity relationship. Recent research has found that firms that export are subsequently more innovative, implying that exporting activity can generate knowledge that is useful for carrying out innovation. In this paper, we extended this line of research to compare the impact of exports and an alternate form of international activity – foreign direct investment – on a firm's innovative learning. We predicted that 1) learning associated with FDI would be greater than that associated with exporting, and that 2) it would take longer to achieve. We also predicted that 3) exports and FDI would function as substitutes in terms of generating such learning for a firm. In an empirical test involving Spanish manufacturing firms between 2000 and 2005, we found evidence supporting the second and third of these predictions, but rejecting

the first of these. Given the implicit belief in prior literature that FDI should generate stronger learning than exporting (e.g., Salomon & Jin 2008), this is a provocative result that deserves more attention in future research.

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Table 1 Industry breakdown of the sample

Industry \ Año	Number of firms						Percentage of total (%)						Product innovation average					
	2000	2001	2002	2003	2004	2005	2000	2001	2002	2003	2004	2005	2000	2001	2002	2003	2004	2005
Meat products	50	45	44	38	38	48	2.67	2.61	2.58	2.75	2.77	2.51	1.41	0.71	0.89	0.92	1.03	0.68
Food and tobacco	173	150	158	128	128	171	9.25	8.7	9.25	9.28	9.32	8.95	1.33	1.27	1.23	0.81	0.97	0.95
Beverages	31	26	26	20	20	43	1.66	1.51	1.52	1.45	1.46	2.25	1.2	0.31	1.32	1.05	1.3	1.34
Textiles and clothing	180	161	160	117	114	157	9.63	9.34	9.37	8.48	8.3	8.22	5.23	13.7	8.22	7.53	5.38	6.7
Leather and footwear	54	49	48	31	31	50	2.89	2.84	2.81	2.25	2.26	2.62	3.94	4.12	1	0.63	0.73	1.94
Wood and wood products	64	57	58	46	46	66	3.42	3.31	3.4	3.33	3.35	3.45	0.22	0.32	0.38	1.87	2.02	0.14
Paper and publishing	60	56	57	46	45	57	3.21	3.25	3.34	3.33	3.28	2.98	1.19	1.02	0.75	1.57	0.76	0.95
Edition and graphic arts	104	96	98	78	77	101	5.56	5.57	5.74	5.65	5.6	5.29	2.71	2.58	2.66	0.19	0.25	0.28
Chemical products	116	108	105	90	89	132	6.2	6.26	6.15	6.52	6.48	6.91	3.06	2.48	3.7	1.58	1.83	1.61
Rubber and plastic products	108	102	102	77	78	93	5.78	5.92	5.97	5.58	5.68	4.87	5.05	1.1	2.4	1.08	1.08	2.42
Non-metallic products	126	116	114	98	97	150	6.74	6.73	6.67	7.1	7.06	7.85	1.89	0.59	2.38	0.39	0.33	1.17
Ferrous and non-ferrous metals	64	60	60	54	55	63	3.42	3.48	3.51	3.91	4	3.3	4.62	2.11	2.5	0.3	0.31	0.65
Metallurgy and metallic products	190	193	189	157	156	239	10.2	11.2	11.1	11.4	11.4	12.5	1.87	1.65	2.01	1.92	2.04	1.25
Agricultural machinery	139	128	125	107	107	135	7.43	7.42	7.32	7.75	7.79	7.06	1.71	1.99	1.61	1.04	1.36	1.12
Office products and data processing	25	26	21	15	15	30	1.34	1.51	1.23	1.09	1.09	1.57	2.56	1.23	0.47	2.07	2.29	2.79
Electrical accessories and materials	117	109	102	78	78	109	6.26	6.32	5.97	5.65	5.68	5.7	2.67	2.31	2.67	1.64	2.64	3.87
Automobiles and motors	102	92	91	72	72	96	5.45	5.34	5.33	5.22	5.24	5.02	1.82	2.09	1.86	2.27	2.63	1.53
Transport material	39	32	33	28	28	48	2.09	1.86	1.93	2.03	2.04	2.51	1.26	0.84	1.06	0.82	0.96	0.57
Furniture products	94	84	84	75	75	90	5.03	4.87	4.92	5.43	5.46	4.71	4.9	1.91	1.16	0.62	1.1	0.47
Miscellaneous Manufacturing	34	34	33	25	25	33	1.82	1.97	1.93	1.81	1.82	1.73	17.6	0.42	1.64	1.12	13.1	1.85
TOTAL	1870	1724	1708	1380	1374	1911	100	100	100	100	100	100	66.2	42.7	39.9	29.4	42.1	32.3

Table 2. Evolution by year of companies developing exports and FDI activities (%)

	2000	2001	2002	2003	2004	2005
Exports	65.11	65.67	64.34	64.18	64.38	62.63
FDI	11.56	13.17	12.82	13.27	13.26	13.34

Table 3: Correlation matrix and descriptive statistics for all variables

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
1 R&DIntensity	1																												
2 LnSize	.171	1																											
3 AdvIntensity	.087	.190	1																										
4 NewProductslag1	.123	.065	.040	1																									
5 NewProductslag2	.114	.065	.051	.582	1																								
6 NewProductslag3	.096	.065	.058	.588	.554	1																							
7 ExportDummylag1	.124	.509	.120	.075	.087	.088	1																						
8 ExportDummylag2	.124	.506	.126	.070	.075	.091	.908	1																					
9 ExportDummylag3	.112	.503	.130	.080	.070	.077	.849	.892	1																				
10 FDIDummylag1	.130	.406	.146	.060	.041	.052	.253	.252	.247	1																			
11 FDIDummylag2	.127	.401	.146	.046	.060	.045	.252	.251	.248	.901	1																		
12 FDIDummylag3	.127	.394	.156	.043	.042	.068	.248	.247	.246	.812	.884	1																	
13 ExportFDIDumlag1	.131	.403	.137	.062	.043	.054	.276	.273	.267	.979	.885	.805	1																
14 ExportFDIDumlag2	.130	.397	.138	.047	.063	.048	.273	.274	.270	.882	.979	.867	.901	1															
15 ExportFDIDumlag3	.131	.389	.147	.043	.044	.071	.266	.269	.271	.796	.864	.977	.815	.882	1														
16 LnExportlag1	.154	.661	.129	.078	.090	.094	.957	.892	.844	.328	.325	.319	.351	.347	.339	1													
17 LnExportlag2	.156	.657	.136	.070	.079	.095	.894	.957	.879	.328	.325	.319	.351	.349	.342	.948	1												
18 LnExportlag3	.144	.655	.141	.085	.070	.082	.849	.883	.956	.323	.325	.321	.345	.348	.346	.909	.938	1											
19 LnFDIlag1	.141	.389	.161	.028	0.020	.032	.219	.217	.210	.844	.779	.713	.834	.769	.702	.296	.295	.289	1										
20 LnFDIlag2	.140	.381	.157	0.017	.029	0.024	.216	.216	.214	.777	.844	.765	.768	.833	.755	.292	.294	.292	.917	1									
21 LnFDIlag3	.139	.371	.168	0.014	0.015	.035	.212	.212	.212	.723	.763	.844	.718	.752	.832	.286	.286	.289	.856	.896	1								
22 Patentslag1	.086	.073	.043	.208	0.017	0.010	.051	.056	.080	.074	.065	.109	.075	.069	.114	.062	.065	.104	.058	.057	.095	1							
23 Patentslag2	.060	.065	.047	0.000	.221	0.019	.058	.049	.053	.074	.070	.056	.075	.072	.060	.067	.060	.061	.066	.051	.046	.145	1						
24 Patentslag3	.038	.059	.058	0.002	0.001	.239	.045	.054	.046	.069	.059	.061	.070	.060	.062	.054	.062	.057	.055	.047	.039	.106	.100	1					
25 LnExportFDIlag1	.142	.392	.150	.027	0.020	.034	.228	.227	.220	.807	.748	.691	.824	.763	.704	.310	.310	.304	.982	.911	.858	.058	.064	.055	1				
26 LnExportFDIlag2	.144	.385	.147	0.014	.029	0.024	.225	.226	.224	.743	.807	.735	.760	.825	.750	.306	.309	.308	.910	.980	.891	.058	.052	.046	.930	1			
27 LnExportFDIlag3	.143	.376	.158	0.012	0.014	.034	.221	.222	.224	.693	.730	.808	.711	.747	.826	.300	.302	.307	.853	.890	.978	.095	.046	.040	.880	.912	1		
28 NewProducts	.094	.063	.039	.593	.608	.482	.069	.078	.074	.045	.044	.053	.046	.044	.051	.070	.084	.080	0.018	0.017	0.029	0.000	0.002	0.005	0.016	0.015	0.027	1	
29 Patents	.061	.080	.030	0.017	0.012	.162	.057	.081	.076	.073	.122	.136	.078	.126	.141	.067	.103	.095	.065	.105	.113	.154	.114	.331	.065	.104	.111	.199	1
Mean	0.722	4.365	1.321	2.425	2.535	2.755	0.646	0.646	0.648	0.128	0.126	0.125	0.123	0.122	0.120	9.630	9.623	9.623	0.155	0.152	0.150	0.220	0.231	0.242	2.545	2.501	2.451	2.297	0.214
s.d.	2.485	1.497	3.253	18.448	19.296	20.776	0.478	0.478	0.478	0.334	0.332	0.331	0.328	0.327	0.325	7.451	7.438	7.421	0.479	0.475	0.470	2.869	3.108	3.373	8.262	8.153	8.041	17.275	2.629

Correlations above .03 are significant at the 0.05 level
Correlations above .05 are significant at the 0.01 level

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TABLE 4

The effect of exporting ($ExportDummy_{jt-m}$) and FDI ($FDIDummy_{jt-m}$) on introduction of products ($NewProducts_{jt}$)
Negative binomial estimation

	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**	**Model 7**	**Model 8**	**Model 9**
R&DIntensity	0.049 *** (0.011)	0.039 *** (0.011)	0.021 *** (0.009)	0.047 *** (0.009)	0.039 *** (0.010)	0.020 ** (0.009)	0.049 *** (0.010)	0.040 *** (0.011)	0.021 ** (0.009)
LnSize	0.263 *** (0.034)	0.314 *** (0.040)	0.412 *** (0.058)	0.339 *** (0.035)	0.351 *** (0.041)	0.499 *** (0.059)	0.242 *** (0.036)	0.273 *** (0.042)	0.399 *** (0.060)
AdvIntensity	0.014 ** (0.006)	0.015 ** (0.006)	0.028 ** (0.015)	0.013 ** (0.006)	0.014 ** (0.006)	0.030 ** (0.015)	0.013 ** (0.006)	0.014 ** (0.006)	0.029 ** (0.015)
NewProductsLag1	0.003 *** (0.001)			0.003 *** (0.001)			0.003 *** (0.001)		
NewProductsLag2		0.000 (0.001)			0.001 (0.001)			0.001 (0.001)	
NewProductsLag3			0.002 *** (0.001)			0.002 *** (0.001)			0.002 *** (0.001)
ExportDummyLag1	0.924 *** (0.117)						0.948 *** (0.122)		
ExportDummyLag2		0.750 *** (0.136)						0.789 *** (0.141)	
ExportDummyLag3			0.686 *** (0.182)						0.818 *** (0.187)
FDIDummyLag1				0.145 * (0.099)			0.484 (0.393)		
FDIDummyLag2					0.351 *** (0.117)			0.895 ** (0.435)	
FDIDummyLag3						-0.085 (0.145)			1.835 *** (0.678)
ExportFDIDumLag							-0.351 (0.396)		
ExportFDIDumLag								-0.577 (0.440)	
ExportFDIDumLag									-1.957 (0.675)
Constant	-2.444 (0.179)	-2.279 (0.215)	-1.840 (0.296)	-2.058 *** (0.183)	-1.879 (0.220)	-1.598 (0.305)	-2.397 *** (0.183)	-2.187 *** (0.218)	-1.879 (0.297)
/ln_r	-0.256 (0.053)	-0.216 (0.058)	0.022 (0.079)	-0.269 (0.053)	-0.222 (0.058)	0.025 (0.080)	-0.253 (0.053)	-0.211 (0.058)	0.031 (0.079)
/ln_s	-1.307 (0.072)	-1.464 (0.078)	-1.858 (0.083)	-1.387 (0.072)	-1.530 (0.078)	-1.928 (0.081)	-1.295 (0.073)	-1.447 (0.079)	-1.845 (0.083)
R	0.774 (0.041)	0.805 (0.047)	1.022 (0.080)	0.763 (0.040)	0.800 (0.047)	1.025 (0.082)	0.776 (0.041)	0.809 (0.047)	1.031 (0.081)
S	0.270 (0.019)	0.231 (0.018)	0.155 (0.012)	0.249 (0.018)	0.216 (0.016)	0.145 (0.011)	0.273 (0.020)	0.235 (0.018)	0.157 (0.013)
Log Likelihood	-6087.3	-4616.5	-2955.4	-6130.7	-4631.7	-2964.7	-6084.3	-4608.3	-2949.5
Wald test	242.5***	157.0***	121.9***	176.1***	128.6***	99.6***	246.1***	168.7***	132.9***
LR test vs. Pool	1858.1***	1492.8***	1254.7***	1911.6***	1554.2***	1293.1***	1832.0***	1480.9***	1245.2***

** p<0.05; *** p<0.01 (one-tailed tests). Standard deviation appears in parentheses ( ).

TABLE 5

The effect of exporting ($LnExport_{jt-m}$) and FDI ($LnFDI_{jt-m}$) on introduction of products ($NewProducts_{jt}$)
Negative binomial estimation

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9
R&DIntensity	0.048 ***	0.039 ***	0.021 **	0.047 ***	0.039 ***	0.020 **	0.046 ***	0.039 ***	0.020 **
	(0.010)	(0.011)	(0.010)	(0.009)	(0.011)	(0.009)	(0.010)	(0.011)	(0.009)
LnSize	0.197 ***	0.264 ***	0.352 ***	0.358 ***	0.377 ***	0.519 ***	0.180 ***	0.233 ***	0.353 ***
	(0.038)	(0.045)	(0.065)	(0.035)	(0.041)	(0.059)	(0.040)	(0.047)	(0.067)
AdvIntensity	0.014 **	0.015 **	0.028	0.013 **	0.015 **	0.033 **	0.013 **	0.014 **	0.032 **
	(0.006)	(0.006)	(0.015)	(0.006)	(0.006)	(0.016)	(0.006)	(0.006)	(0.016)
NewProductsLag1	0.003 ***			0.003			0.003 ***		
	(0.001)			(0.001)			(0.0001)		
NewProductsLag2		0.000			0.001			0.000	
		(0.001)			(0.001)			(0.001)	
NewProductsLag3			0.002 **			0.002 ***			0.002 ***
			(0.001)			(0.001)			(0.001)
LnExportLag1	0.062 ***						0.070 ***		
	(0.008)						(0.008)		
LnExportLag2		0.050 ***						0.058 ***	
		(0.009)						(0.010)	
LnExportLag3			0.051 ***						0.060 ***
			(0.013)						(0.013)
LnFDILag1				-0.002			1.291 ***		
				(0.075)			(0.394)		
LnFDILag2					0.073			1.540 ***	
					(0.088)			(0.448)	
LnFDILag3						-0.226			1.612 **
						(0.122)			(0.640)
LnExportFDILag1							-0.076 ***		
							(0.022)		
LnExportFDILag2								-0.087 ***	
								(0.025)	
LnExportFDILag3									-0.109 ***
									(0.037)
Constant	-2.151 ***	-2.057 ***	-1.619 ***	-2.114 ***	-1.953 ***	-1.672 ***	-2.181 ***	-2.048 ***	-1.722 ***
	(0.174)	(0.209)	(0.290)	(0.184)	(0.221)	(0.306)	(0.178)	(0.212)	(0.291)
/ln_r	-0.257	-0.217	0.023	-0.271	-0.227	0.022	-0.255	-0.212	0.025
	(0.053)	(0.058)	(0.079)	(0.053)	(0.058)	(0.080)	(0.053)	(0.058)	(0.078)
/ln_s	-1.307	-1.465	-1.861	-1.393	-1.538	-1.929	-1.292	-1.443	-1.843
	(0.073)	(0.079)	(0.083)	(0.071)	(0.077)	(0.081)	(0.073)	(0.079)	(0.083)
R	0.773	0.804	1.023	0.762	0.796	1.022	0.774	0.808	1.025
	(0.041)	(0.047)	(0.080)	(0.040)	(0.046)	(0.082)	(0.041)	(0.047)	(0.080)
S	0.270	0.230	0.155	0.248	0.214	0.145	0.274	0.236	0.158
	(0.019)	(0.018)	(0.012)	(0.017)	(0.016)	(0.011)	(0.020)	(0.018)	(0.013)
Log Likelihood	-6090.6	-4616.1	-2955.4	-6131.8	-4635.8	-2963.2	-6083.0	-4608.8	-2947.61
Wald test	237.2***	154.4***	121.6***	173.6***	119.1***	104.0***	252.6***	168.7***	137.63***
LR test vs. pool	1851.8***	1495.5***	1261.0***	1931.7***	1552.4***	1301.4***	1839.7***	1485.6***	1258.59***

** p<0.05; *** p<0.01 (one-tailed tests). Standard deviation appears in parentheses ( ).

TABLE 6

The effect of exporting ($ExportDummy_{jt-m}$) and FDI ($FDIDummy_{jt-m}$) on patenting activity ($Patents_{jt}$)
Negative binomial estimation

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9
R&DIntensity	0.073 ***	0.103 ***	0.074 ***	0.073 ***	0.105 ***	0.078 ***	0.071 ***	0.103	0.074 ***
	(0.022)	(0.024)	(0.028)	(0.022)	(0.025)	(0.029)	(0.022)	(0.025)	(0.028)
LnSize	0.408 ***	0.444 ***	0.400 ***	0.502 ***	0.531 ***	0.518 ***	0.386 ***	0.434	0.403 ***
	(0.062)	(0.072)	(0.084)	(0.063)	(0.074)	(0.087)	(0.067)	(0.078)	(0.091)
AdvIntensity	0.024	0.004	0.011	0.024	0.006	0.023	0.021	0.003	0.011
	(0.022)	(0.026)	(0.037)	(0.022)	(0.027)	(0.037)	(0.022)	(0.027)	(0.037)
PatentsLag1	-0.006			-0.005			-0.005		
	(0.006)			(0.006)			(0.006)		
PatentsLag2		-0.030 **			-0.030 **			-0.030	
		(0.012)			(0.013)			(0.013)	
PatentsLag3			0.014 ***			0.014 ***			0.014 ***
			(0.005)			(0.004)			(0.005)
ExportDummyLag1	1.141 ***						1.143 ***		
	(0.250)						(0.252)		
ExportDummyLag2		1.012 ***						1.026	
		(0.270)						(0.275)	
ExportDummyLag3			1.105 ***						1.130 ***
			(0.332)						(0.341)
FDIDummyLag1				0.163			0.591		
				(0.184)			(1.316)		
FDIDummyLag2					0.085			0.815	
					(0.212)			(1.480)	
FDIDummyLag3						-0.016			0.616
						(0.274)			(1.556)
ExportFDIDumLag1							-0.439		
							(1.322)		
ExportFDIDumLag2								-0.768	
								(1.486)	
ExportFDIDumLag3									-0.671
									(1.568)
Constant	-3.851	-3.580	-3.376	-3.365	-3.139	-3.026	-3.793	-3.553	-3.395 ***
	(0.340)	(0.386)	(0.470)	(0.330)	(0.381)	(0.458)	(0.348)	(0.396)	(0.478)
/ln_r	0.101	0.173	0.252	0.079	0.172	0.258	0.105	0.168	0.252
	(0.100)	(0.115)	(0.142)	(0.099)	(0.115)	(0.142)	(0.100)	(0.115)	(0.142)
/ln_s	-2.166	-2.297	-2.387	-2.244	-2.364	-2.434	-2.147	-2.305	-2.391
	(0.120)	(0.134)	(0.161)	(0.122)	(0.136)	(0.167)	(0.123)	(0.137)	(0.167)
R	1.107	1.189	1.287	1.083	1.187	1.294	1.111	1.183	1.287
	(0.111)	(0.137)	(0.183)	(0.107)	(0.136)	(0.184)	(0.111)	(0.136)	(0.183)
S	0.114	0.100	0.091	0.105	0.093	0.087	0.116	0.099	0.091
	(0.013)	(0.013)	(0.014)	(0.012)	(0.012)	(0.014)	(0.014)	(0.013)	(0.015)
Log Likelihood	1754.6	-1385.0	-925.8	-1782.4	-1398.0	-936.9	-1753.7	-925.3	-1380.7
Wald Test	128.6***	108.4***	80.0***	112.8***	94.2***	71.1***	130.3***	79.6***	107.7***
LR test vs pool	612.8***	454.9***	292.0***	610.8***	449.5***	288.8***	572.6***	274.6***	427.8***

TABLE 7

The effect of exporting ($LnExport_{jt-m}$) and FDI ($LnFDI_{jt-m}$) on patenting activity ($Patents_{jt}$)
Negative binomial estimation

	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**	**Model 7**	Model 8	Model 9
R&DIntensity	0.071 ***	0.100 ***	0.069 **	0.074 ***	0.104 ***	0.078 ***	0.070 ***	0.098 ***	0.069
	(0.022)	(0.025)	(0.029)	(0.022)	(0.026)	(0.029)	(0.022)	(0.025)	(0.029)
LnSize	0.304 ***	0.359 ***	0.321 ***	0.516 ***	0.538 ***	0.503 ***	0.299 ***	0.356 ***	0.312
	(0.073)	(0.083)	(0.099)	(0.061)	(0.072)	(0.084)	(0.075)	(0.086)	(0.101)
AdvIntensity	0.025	0.006	0.014	0.025	0.007	0.021	0.024	0.006	0.012
	(0.022)	(0.026)	(0.036)	(0.022)	(0.027)	(0.037)	(0.022)	(0.026)	(0.036)
PatentsLag1	-0.006			-0.006			-0.006		
	(0.006)			(0.006)			(0.006)		
PatentsLag2		-0.031 **			-0.030 **			-0.031 **	
		(0.0131)			(0.013)			(0.013)	
PatentsLag3			0.013 ***			0.014 ***			0.014
			(0.004)			(0.004)			(0.005)
LnExportLag1	0.083 ***						0.084 ***		
	(0.017)						(0.018)		
LnExportLag2		0.072 ***						0.071 ***	
		(0.019)						(0.019)	
LnExportLag3			0.072 ***						0.073
			(0.023)						(0.023)
LnFDILag1				0.0424			0.682		
				(0.120)			(0.824)		
LnFDILag2					0.028			-0.235	
					(0.142)			(1.075)	
LnFDILag3						0.080			0.479
						(0.187)			(0.874)
LnExportFDILag1							-0.038		
							(0.047)		
LnExportFDILag2								0.015	
								(0.063)	
LnExportFDILag3									-0.025
									(0.051)
Constant	-3.436 ***	-3.216 ***	-2.960 ***	-3.403 ***	-3.155 ***	-2.998 ***	-3.443 ***	-3.184 ***	-2.964
	(0.321)	(0.371)	(0.453)	(0.329)	(0.379)	(0.455)	(0.327)	(0.379)	(0.457)
/ln_r	0.104	0.178	0.252	0.076	0.171	0.256	0.104	0.175	0.250
	(0.100)	(0.116)	(0.142)	(0.099)	(0.115)	(0.141)	(0.100)	(0.116)	(0.142)
/ln_s	-2.174	-2.308	-2.403	-2.257	-2.371	-2.418	-2.167	-2.321	-2.385
	(0.120)	(0.133)	(0.161)	(0.120)	(0.135)	(0.164)	(0.121)	(0.135)	(0.165)
R	1.110	1.195	1.286	1.079	1.187	1.292	1.110	1.191	1.284
	(0.111)	(0.138)	(0.183)	(0.107)	(0.136)	(0.183)	(0.111)	(0.138)	(0.182)
S	0.113	0.099	0.090	0.104	0.093	0.089	0.114	0.098	0.092
	(0.013)	(0.013)	(0.014)	(0.012)	(0.012)	(0.014)	(0.013)	(0.0133)	(0.015)
Log Likelihood	-1754.4	-1384.9	-926.7	-1783.7	-1398.0	-936.8	-1753.5	-1380.7	-926.2483
Wald Test	131.5***	109.9***	80.5***	111.7***	93.7***	71.9***	132.4***	108.6***	81.03***
LR test vs pool	617.1***	457.8***	293.6***	637.1***	465.9***	299.7***	599.2***	444.1***	284.59***

Figure 1: Patenting activity by sample firms 2000-2005, by category of international activity

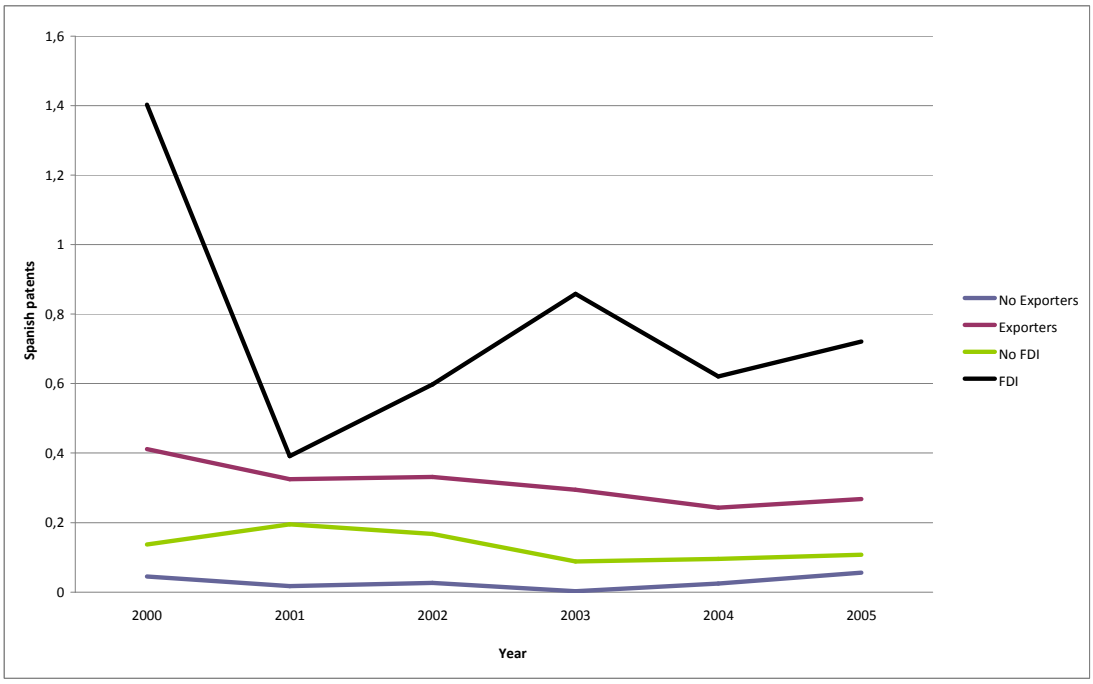

Figure 2: New product introductions by sample firms 2000-2005, by category of international activity